ROHINI COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS INSTITUTION
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

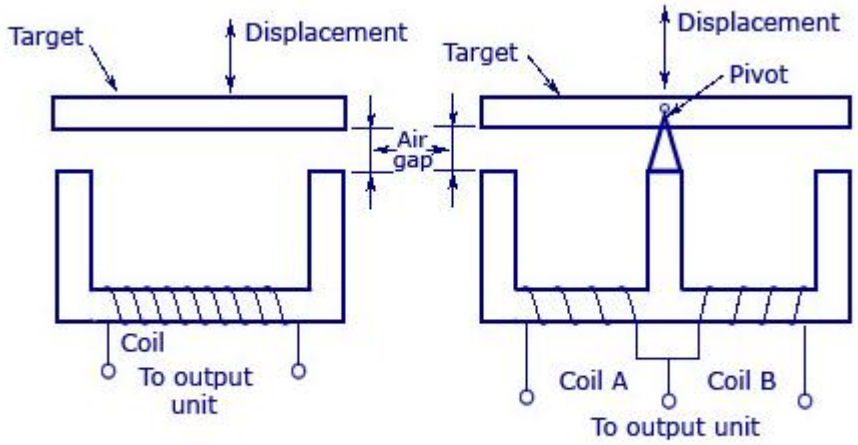
VII Semester

AU3008 Sensors and Actuators

UNIT – 2 - Variable Resistance and Inductance Sensors

2.7 Variable Reluctance Transducer

Variable Reluctance Transducers (VRTs) are electromechanical transducers that convert mechanical motion into an electrical signal. They operate on the principle of varying magnetic reluctance.



Two Configuration of Variable reluctance Type Proximity Transducers

- The device consists of a coil that is wound on a core made up of ferromagnetic material.
- The displacement is given to the core through a target that makes an upward and downward movement according to the displacement produced.
- It does not touch the core of the coil and a smaller air gap is made between them.

- When the target moves closer to the coil due to the displacement, the air gap becomes less causing the reluctance of the magnetic field to reduce and thus the coil inductance to increase.
- The value of inductance keeps on varying according to the variation in target movement.
- A CRO or a recorder takes these values and displays it to the user.
- In the right-side figure shown above, an E-type core is used for finding the displacement.
- The target is also pivoted at the central limb of the core. Thus, a single coil is divided into two turns and the end of each coil works as the arms of an inductance bridge.
- As the displacement value changes, an output signal is produced. This is given to a CRO after amplification.
- The biggest advantage of this device is that it shows a linear relationship between the output and the displacement.

Key components of a VRT:

- **Core:** A magnetic core made of a high-permeability material like soft iron or laminated steel.
- **Coils:** Multiple coils wound around the core, carrying an alternating current (AC) to create a magnetic field.
- **Moving part:** A mechanical element that moves the core, changing the air gap within the magnetic circuit.

Working:

- **Magnetic Field:** The AC current in the coils creates a magnetic field within the core.
- **Reluctance Variation:** As the moving part changes the air gap, the magnetic reluctance of the circuit varies.
- **Induced EMF:** The changing magnetic flux induces an electromotive force (EMF) in the coils.
- **Output Signal:** The induced EMF is the output signal of the VRT, which is proportional to the mechanical motion.

Common applications of VRTs:

- **Rotary motion sensing:** Measuring rotational speed, angular position, and vibration.
- **Linear position sensing:** Measuring linear displacement, such as the position of a piston or valve.
- **Force and torque measurement:** Measuring forces and torques by relating them to mechanical displacements.

dvantages of VRTs:

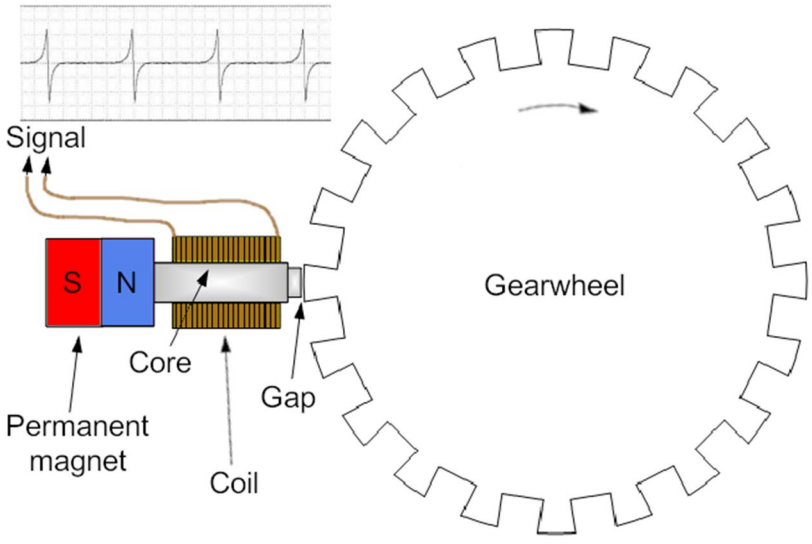
- Simple construction
- High sensitivity
- Ruggedness
- Low cost

Disadvantages of VRTs:

- Non-linear output
- Susceptible to external magnetic fields
- Limited frequency response

VRTs are widely used in various industries, including automotive, aerospace, and industrial automation, due to their reliability, versatility, and cost-effectiveness.

Example:



- VR sensors take advantage of this magnetic property. They combine a permanent magnet and a coil. The diagram (fig. 1) represents such a sensor. The core of the coil is placed near a rotating gear.
- Each time a tooth passes near the sensor, the reluctance of the magnetic circuit generated by the permanent magnet is modified. Therefore, the magnetic field is also modified. This induces a current in the coil and, thus, a voltage signal.
- The frequency and amplitude of the signal are proportional to the rotation speed. The amplitude is inversely proportional to the thickness of the air gap between the sensor and the teeth of the wheel. Therefore, the main disadvantage of this sensor is that it cannot detect movements that are too slow or too distant.
- The direction of rotation does not modify the signal. In the example in the figure above, if you want each period to start with the negative part, you must swap the sensor wires and not change the gear wheel's rotation direction.

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